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APPLICATION FOR UNITED STATES LETTERS PATENT

FOR

COOPERATIVE WIRELESS LUMINESCENT IMAGERY

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Cooperative Wireless Luminescent Imagery

RELATED APPLICATIONS

The present application is a continuation-in-part application of copending U.S. Patent Application number 09/908,118, filed July 17, 2001, entitled "LUMINESCENT SIGNALING DISPLAYS UTILIZING A WIRELESS MOBILE COMMUNICATION DEVICE", and claims priority to U.S. Provisional Patent Application number 60/306,326, filed July 17, 2001, entitled "Personalizing Electronic Devices and Smart Covering". The specifications of these applications are herein fully incorporated by reference.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates to the field of wireless mobile communications. More specifically, the present invention relates to cooperative display of luminescent patterns to further improve the communication and entertainment aspects of wireless mobile communication devices.

2. BACKGROUND INFORMATION

Advances in integrated circuit and telecommunication technology have led to wide spread adoption of wireless mobile client devices, in particular, wireless mobile phones. Wireless mobile phones are popular, partly because they offer the advantage of enabling their users to be communicatively reachable by their business associates, friends and family members, wherever the users may be, as long as they are within the

reach of the service networks. Aside from convenience, wireless mobile phones are also popular due to their relatively affordable price as the cost for owning and using a wireless mobile phone today is well within the ability of many non-professionals. In fact, ever since their initial introductions, the cost for owning and using wireless mobile phones has steadily declined. As the cost of ownership has continued to decrease, successive generations of wireless mobile phones, as well as wireless client devices in general, have also included more functions and increased performance in a smaller package.

In fact, given the widespread availability of wireless mobile clients, both manufacturers and service providers alike are continually being pressured to improve the features available and services offered to users through their wireless mobile clients. In particular, as the number of wireless mobile clients including mobile phones used by non-professionals continues to increase, the demand for entertainment based mobile applications and even games also continues to increase. Even though manufacturers and service providers continue to improve such offerings, a greater number of features and improved functionality nonetheless remains desirable.

BRIEF DESCRIPTION OF DRAWINGS

The present invention is illustrated by way of example and not by way of limitation in the figures of the accompanying drawings, in which like references indicate similar elements and in which:

Figures 1(A-D) illustrate an overview of the present invention, in accordance with various embodiments;

Figure 2 illustrates a functional view of the visualization feature of present invention for wireless mobile phones, in accordance with one embodiment;

Figure 3 is a block diagram illustrating a functional view of one embodiment of a communication server incorporating the teachings of the present invention;

Figures 4A-4C illustrate various example data organizations suitable for use to store various visualization configuration related information for practicing the present invention, in accordance with one embodiment;

Figure 5 illustrates an exemplary operational flow of one embodiment of the present invention;

Figure 6 illustrates an exemplary operational flow performed by visualization controller **212** and visualization agent **204** of wireless mobile phone **200** to display one or more luminescent patterns, in accordance with one embodiment;

Figures 7A-7B illustrate an external view of a wireless mobile phone **200a**, incorporated with the visualization teachings of the present invention, in accordance with one embodiment;

Figures 8A-8B illustrate an exposed view of wireless mobile phone **200b**, in accordance with an alternate embodiment;

Figure 9 illustrates an internal component view of wireless mobile phone **200**, in accordance with one embodiment; and

Figure 10 illustrates an internal component view of an "active" version of interchangeable "cover" **821**, in accordance with one embodiment.

DETAILED DESCRIPTION

The present invention provides for cooperative and synchronized display of one or more luminescent images by a community of wireless mobile devices such as wireless mobile phones. In the description to follow, for purposes of explanation, various details are set forth in order to facilitate a thorough understanding of the present invention. However, the present invention may be practiced without some or many of the specific details. In other instances, in order not to obscure the present invention, well-known features are omitted, simplified or merely briefly described.

The description will be presented using terms that are commonly employed by those skilled in the art of wireless mobile communications to convey the substance of their work to others skilled in the same art. Examples of these terms include but are not limited to transmitting, receiving, determining, requesting, and so forth. As those skilled in the art of wireless mobile communications would appreciate, these quantities may take the form of electrical, magnetic, or optical signals, and the operations involve corresponding processing of these signals by electrical, magnetic, or optical components.

The terms "wireless communication device" and "wireless mobile client" are interchangeably used herein to refer to a class of electronic communications devices that enable a user to receive, and in some cases transmit, electronic communications signals including both analog and digital communications signals. Such wireless communication devices include, but are not limited to wireless mobile telephones and land-line telephones, pagers, walkie-talkies, personal digital assistants, and so forth.

The term "wireless mobile phone" as used herein refers to the class of telephone devices equipped to enable a user to make and receive calls wirelessly, notwithstanding the user's movement, as long as the user is within the communication reach of a "service or base station". Unless specifically excluded, the term "wireless mobile phone" is to include the analog subclass as well as the digital subclass (of all signaling protocols).

Various operations will be described as multiple discrete steps in turn, in a manner that is most helpful in understanding the present invention. However, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations need not be performed in the order of presentation. Furthermore, the phrase "in one embodiment" will be repeatedly employed in the description to follow. In general, the phrase does not refer to the same embodiment, although in some instances it may.

Reference is now made to **Figure 1A**, where an overview of the present invention is illustrated. As shown, communication server **102** is communicatively coupled to wireless mobile clients **108** via wireless transmission network **104**. Wireless transmission network **104** is intended to represent a broad category of wireless and wireline transmission networks to provide wireless communication capabilities, and optionally telephony capabilities, to wireless mobile clients **108**. Wireless transmission network **104** may consist of one or more communication networks employing one or more signaling protocols, including, but not limited to, code division multiple access (CDMA), time division multiple access (TDMA), global system for mobile communications (GSM), cellular digital packet data (CDPD), and so forth. Each such

communication network may further be comprised of one or more transmitters, receivers, relays, base stations, and so forth, depending e.g. upon the implementation and physical separation between communication server **102** and wireless transmission network **104**.

Wireless mobile clients **108** are collocated with one another at venue **106** and represent various ones of a class of wireless mobile client devices including, but not limited to wireless mobile phones, palm-top computers such as a personal digital assistant (PDA), two-way pagers, and so forth. Venue **106** is illustrated to represent a stadium equipped to hold tens, hundreds, thousands, or even hundreds of thousands of people or "users" furnished with wireless mobile client devices. In one embodiment of the present invention, participating ones of wireless mobile clients **108**, with support from communication server **102**, display luminescent patterns that cooperatively combine to form an audience assisted luminescent image (hereinafter referred to as a "crowd pattern"). In another embodiment, select ones of wireless mobile clients **108** cooperatively display sequences of synchronized crowd patterns to convey a sense of motion or luminescent animation. For example, a first group of wireless mobile clients **108** in a first location may each display a first luminescent pattern at a time interval *T*1 and a second luminescent pattern at a time interval *T*2, whereas a second group of wireless mobile clients **108** in a second location may not display any luminescent image at time *T*1, but may each then display the first luminescent pattern at time *T*2. Thus, by varying the luminescent patterns displayed by a group of wireless mobile clients over time, a sense of motion may be imparted to a crowd or audience.

Crowd patterns may originate from a number of sources both static and dynamic. For example, a number of pre-programmed crowd patterns (or luminescent patterns) may be stored in one or more wireless mobile clients (e.g. in static memory) for later display in cooperation with addition wireless mobile clients. Alternatively, one or more dynamic sources may be utilized to facilitate generation of one or more crowd patterns. For example, a video camera could be used in association with communication server **102** to capture image sequences to be displayed as one or more crowd patterns. Communication server **102** would process sequences of video images received from the video camera an subdivide each image into portions that may then be transmitted as luminescent patterns to individual wireless mobile clients based upon their location. The devices would then display each respective portion such that the crowd pattern resembles the original video image. Crowd patterns may approximate a wide variety of other visual queues including stage light shows, "screen savers", color organs and so forth.

Each luminescent pattern displayed by a single wireless mobile client essentially forms a constituent portion; or "picture element" of the larger crowd pattern. In one embodiment, wireless mobile clients **108** cooperatively display luminescent patterns via one or more light emitting devices (LED) disposed on or within or connected to each respective wireless mobile client. As used herein, the terms "light emitting device" and "LED" generally refer to a device or component equipped to illuminate to form one or more constituent portions of a luminescent pattern. LEDs may include, but are not limited to devices such as light emitting diodes and components such as backlit displays. In one embodiment, LEDs may include multicolor LEDs to enhance the

variety of patterns and imagery conveyed through the luminescent patterns. The greater the number of wireless mobile clients that participate in displaying a particular crowd pattern, the greater the density and corresponding resolution of the crowd pattern. The lower the number of wireless mobile clients that participate in displaying a particular crowd pattern, the lower the density and corresponding resolution of the crowd pattern. For example, if 10,000 wireless mobile clients each use a backlit display as a light-emitting device in the display of a crowd pattern, the equivalent resolution could be said to be 10,000 picture elements. However, if each wireless mobile client were to contain 10 light emitting diodes as a light-emitting device in the display of a crowd pattern, the equivalent resolution could be said to be 100,000 picture elements. Generally, the greater the resolution, the more realistic an animation or video sequence may appear.

In accordance with one embodiment of the invention, each of the picture elements of the crowd pattern to be displayed correspond to and are determined based upon the associated wireless mobile client's positioning relative to its location within venue **106** or relative to the location of other wireless mobile clients **108**, or both. In one embodiment, select ones of wireless mobile clients **108** each only receive a location-specific luminescent pattern to be cooperatively displayed by the selected wireless mobile clients in association with other wireless mobile clients collocated at venue **106** to visually convey the larger crowd pattern. In an alternative embodiment, wireless mobile clients **108** may receive multiple constituent portions of a given crowd pattern or even an entire crowd pattern (i.e. including luminescent patterns to be displayed by other wireless mobile clients), and determine which constituent portion or portions of the

crowd pattern are to be displayed by a given wireless mobile client. In one embodiment, communication server **102** transmits instructions to wireless mobile clients **108** that allow a given one of wireless mobile clients **108** to determine its respective portion of the crowd pattern to be displayed.

In a further embodiment of the invention, select ones of wireless mobile clients **108** each synchronously display a sequence of luminescent patterns in cooperation with others of wireless mobile clients **108** to visually convey an animated crowd pattern or sequence of patterns. In accordance with various embodiments of the invention, communication server **102** facilitates the synchronization of luminescent displays between wireless mobile clients **108** participating in the display of one or more animated crowd patterns. **Figures 1(B-D)** together illustrate an exemplary animation of a crowd pattern at various stages in time. **Figure 1B** represents a first illumination pattern corresponding to a first time frame, whereas **Figures 1C** and **1D** illustrate second and third illumination patterns corresponding to second and third time frames of the animation, respectively. In the exemplary animation of **Figures 1(B-D)**, a first set of wireless mobile clients (**110**) are shown illuminating their respective LEDs in a first color (e.g. red), and a second set of wireless mobile clients (**112**) are shown illuminating their respective LED's in a second color (e.g. yellow), to simulate a 'wave' traversing the stadium.

Reference is now drawn to **Figure 2**, wherein a block diagram illustrating a functional view of one embodiment of a wireless mobile phone incorporating the teachings of the present invention, is shown. As illustrated, wireless mobile phone **200** is provided with a number of light emitting devices ("LEDs") **214**, and visualizer **202**

including visualization controller **212**. For the illustrated embodiment, visualizer **202** also includes client visualization agent **204**.

LEDs **214** are employed by visualizer **202** to effectuate visualization of various luminescent patterns to enhance and supplement a user's experience in using wireless mobile phone **200**. More specifically, the desired visualizations are effectuated by visualization controller **212** selectively activating and de-activating selected ones of LEDs **214** in selected manners, as requested by the requestors it serves, such as client based visualization agent **204** and one or more complimentary server based visualization agents.

Beside LEDs **214** and visualizer **202**, for the illustrated embodiment, wireless mobile phone **200** also includes other hardware and software components **222** and **224**. Other hardware components **222** include, in particular, a microprocessor for processing instructions, an input keypad for entering data and commands, a visual display for displaying information for the user, and a transceiver for sending and receiving signals wirelessly. Other software components **224** include, in particular, corresponding device drivers (e.g. for controlling the input keypad and the visual display), system services (e.g. graphics and audio services), various applications (e.g. dial list, call log, and so forth), and an optional browser (e.g. for accessing the WWW).

The number of LEDs **214** to be employed as well as the manner in which they may be arranged are embodiment or configuration dependent. In one embodiment, a single column of LEDs **214** disposed on a side surface of wireless mobile phone **200** (as illustrated by **Fig. 7A**) is employed. In another embodiment, a collection of LEDs **214** "integrally" arranged around or under the input keys of wireless mobile phone **200** (as

illustrated by **Fig. 8A**) or a collection of LEDs **214** "integrally" arranged on or around an antenna of wireless mobile phone **200** may be employed. In a further embodiment, an LED in the form of a backlit display is employed to provide cooperative luminescent displays. In yet another embodiment, the LEDs may be disposed within a wireless client device having a translucent or transparent case such that when activated, light shone from the LEDs are perceivable through the case. In general, more variations, patterns and manners of visualization may be effectuated if more LEDs **214** are employed. However, for each embodiment or configuration, the number of LEDs **214** employable may be constrained by cost, as well as by the spatial limitations imposed by the physical dimension and the number of other features included with the particular embodiment/configuration of wireless mobile phone **200**.

In one embodiment LEDs **214** represent light emitting diodes, which may be preferred for their relatively low power consumption and compactness in size. Together, these attributes allow a greater number of individually illuminable light sources to be employed. In turn, the greater number of illuminable sources allows more variations in the manner the illuminable light sources may be arranged and disposed. However, in alternate embodiments, other light sourcing elements may also be employed for the practice of the present invention. Accordingly, the term "LEDs" as used herein and in the claims are to be broadly construed, and given its conventional meaning as well as an expansive meaning including light sourcing elements with like attributes.

As described earlier, visualization controller **212** is employed to perform the earlier described selective activation and deactivation of selected ones of LEDs **214** in

selected manners to visually convey the luminescent imagery of the present invention. For the illustrated embodiment, visualization agent **204** is responsible for invoking visualization controller **212** to direct the activations and deactivations of LEDs **214** to achieve the desired visualization for a corresponding luminescent pattern. More specifically, visualization agent **204** is responsible for invoking visualization controller **212** to direct LEDs **214** to effectuate visual conveyance of various luminescent patterns.

For the illustrated embodiment, visualizer controller **212** advantageously offers at least two manners in which a visualization agent may request a visualization operation or operations to be performed. These two manners include a first manner where a singular round of activation and deactivation of LEDs **214** may be requested, and a second manner where a number of rounds or sequences of activation and deactivation of LEDs **214** may be simultaneously requested via a single request.

In one embodiment, the first manner is requested via a function call to visualization controller **212**, providing visualization controller **212** with the identifiers of LEDs **214** to be activated, as well as optional durations of activation. For this embodiment, all other unspecified LEDs **214** are assumed to remain deactivated. In an alternate embodiment, visualization agent **204** may send commands to visualization controller **212** at regular or irregular intervals with each command including a specification stipulating whether each LED is to be set to on or off. In alternate embodiments, group specifications in particular, an "ALL" LED group may be advantageously supported. Additionally, in various embodiments, the intensity or brightest of each LED may be specified (e.g. by way of an intensity/brightness index in

the range e.g. of 0 through 16). Further, for multi-colored LEDs, the color may be specified.

In one embodiment, the second manner is requested via a function call to visualization controller **212**, providing visualization controller **212** with a pointer to a starting location in the included memory of wireless mobile phone **200**, where a data structure containing a series of rounds or cycles of activation and deactivation specifications is stored. The function call, in addition to the pointer, also includes the size of the data structure. In alternate embodiments, a predetermined end of structure demarcation may be employed, in lieu of a size specification. In other embodiments, visualization controller **212** may be given an encoded set of instructions used to produce visualization picture elements for one or more round/cycle (i.e. "Frame"). For each frame of activation and deactivation, the LEDs to be turned on and off are identified. For example, for a row of eight LEDs, the LEDs to be turned on and off for a round or cycle may be specified by the "vector" [01010111] with "0" denoting an "off" state and "1" denoting an "on" state. In alternate embodiments, other manners of specification as well as other manners of providing the specification may be employed instead. Further, as before, the intensity/brightness as well as color (in the case of multi-color LEDs) may be specified.

The above-described approaches are just two exemplary approaches where a visualization agent may request visualization controller **212** to selectively activate and deactivate LEDs **214** on its behalf. Further in the illustrated embodiment, visualization agent **204** is provided to facilitate the conveyance of the desired visualizations, such that the desired visualizations may be achieved without requiring or merely requiring a

relatively small amount of modifications to the main line logic or operational components of wireless mobile phone **200**. However, in embodiments where the earlier described "request" interface of visualization controller **212** is practiced, the visualization services offered by visualization controller **212** may also be directly invoked by the other components of wireless mobile phone **200** instead, should direct incorporation of the required logic into these other components of wireless mobile phone **200** to practice the present invention be desirable. Thus, generically, a visualization requestor, whether it is an "intervening" agent like visualization agent **204** or a functional "principal" (such as the component responsible for incoming call notification), may be referred to as a visualization "client".

Figure 3 is a block diagram illustrating a functional view of one embodiment of a communication server incorporating the teachings of the present invention. As illustrated, in accordance with the present invention, communication server **300** includes server visualization agent **304** providing registration services **305**, pattern selection services **306**, and synchronization services **307**. Communication server **300** further includes visualization configuration records **310** and transmit/receive interface **312**. Although communication server **300** may include additional functional elements such as an operating system, various device drivers and additional system services, these elements have been omitted from the illustrated embodiment for the purpose of clarity.

In accordance with the teachings of the present invention, communication server **300** facilitates the display of one or more luminescent patterns by participating ones of wireless mobile devices **108**. In one embodiment, communication server **300** identifies

which of wireless mobile clients **108** are to participate in the display of one or more luminescent crowd patterns, and which picture elements are to be displayed by each of the participating ones of wireless mobile clients **108**. In one embodiment, communication server **300** determines which constituent luminescent pattern(s) of the larger crowd pattern are to be transmitted to the participating ones of wireless mobile clients **108**. Such a determination may be made e.g. based upon the relative location of the participating wireless mobile clients **108** as determined with respect to the location of other wireless mobile clients, or with respect to a fixed location within a given venue. In another embodiment, communication server **300** may transmit an entire crowd pattern to one or more wireless mobile clients leaving the responsibility of luminescent pattern selection up to the individual wireless mobile client. By doing so, communication server is freed from the processing requirements associated with determining which one or more constituent luminescent pattern(s) are to be displayed by a given wireless mobile client.

Registration services **305** are responsible for identifying which one or more wireless mobile clients are to participate in the luminescent display of one or more crowd patterns, and to store identifiers for each such participating wireless mobile client in e.g. visualization configuration records **310**. In accordance with one embodiment of the invention, visualization agent **304** provides interactive voice response services, which may be responsive to voice and/or DTMF tones supplied by users of wireless mobile clients. In such an embodiment, users of wireless mobile clients **108** may call a generic dial number associated with communication server **300** to register himself or herself as participating in the display of one or more crowd patterns. User registration

may be accomplished e.g. by the user reacting to voice prompts guiding the user through a call tree until an appropriate selection has been made. For example, a user may be able to enter an event code (e.g. '126') representing the related event (and by association, the venue), which is then associated with a user-specific identifier. In one embodiment, the user-specific identifier is the dial number associated with the user's wireless mobile client, which may be obtained through e.g. a dialed number identification service (DNIS). In other embodiments, users of wireless mobile clients **108** may register as participating in the display of one or more crowd patterns via one or more packet-based wireless technologies such as the web access protocol (WAP) messages, as well as through short message service (SMS) messages, for example.

Once the user has been identified to communication server **300**, the user may continue by providing the user's location to communication server **300**. For example, the user may provide their respective venue seating information (i.e. section number, row number, seat number and so forth) to communication server **300**, which is further stored in visualization configuration records **310** in association with the user-specific identifier. In other embodiments, users' locations may be determined by positional systems such as GPS that are based on triangulation. However, location information will be only as accurate as is allowed by the particular positional system based upon technological limitations as well as any artificial accuracy limitations that may be imposed by a group such as e.g. the Government or military. In an alternative embodiment, rather than calling a generic dial number to register as a participating user, users may call an event-specific dial number pre-associated with a particular event

and/or venue. Accordingly, the user may not be required to provide an event and/or venue specific code when registering with communication server **300**.

In certain embodiments, the communication session established between a wireless mobile client and communication server **300** is terminated once the user has registered their identity (and perhaps location) with the communication server, and the appropriate one or more luminescent patterns have been received by the wireless mobile client from the communication server. In other embodiments, the communication session established between a wireless mobile client and communication server **300** is sustained for a longer duration. In one embodiment, the communication sessions between communication server **300** and wireless mobile clients **108** may be sustained for an extended duration such that communication server **300** may periodically transmit new patterns or sequences to the crowd. For example, communication server **300** may transmit a single pattern every 1/10 of a second in order to maintain synchronization between wireless mobile clients **108** and communication server **300**. In other embodiments, the communication sessions between communication server **300** and wireless mobile clients **108** may be sustained for an extended duration to allow for further interaction (i.e. feedback) between the user and the communication server. More specifically, participating (i.e. registered) users within a given venue may be verbally solicited with a question that is posed to the crowd via the public address system or through the one or more wireless mobile clients. In response, the communication server may then transmit one or more luminescent patterns to the responding wireless mobile clients based upon the users' respective responses to the questions. For example, spectators at a sporting event may be asked

trivia questions about a player or sport team, or the spectators may be encouraged to make as much noise as possible. In response to the answers provided by users, or level of noise created by the crowd (e.g. on a section-by-section basis or and individual basis), communication server **300** would provide an appropriate luminescent pattern for display by each respective wireless mobile client.

Referring once again to **Figure 3**, pattern selection services **306** assists in determining which luminescent pattern or patterns are to be transmitted to wireless mobile clients **108**. The patterns to be transmitted to a given wireless mobile client may be determined based upon one or more criteria including, but not limited to venue identification, event type, wireless mobile client location, dial number used during registration, feedback from the wireless mobile client, and so forth. In one embodiment, representations of constituent luminescent patterns are stored within visualization configuration records **310** for retrieval and transmission to one or more wireless mobile clients **108**.

From time to time, it may be desirable to synchronize one or more luminescent patterns to be displayed by multiple wireless mobile clients, or sequences of luminescent patterns to be displayed by one or more wireless mobile clients. For example, to impart a sense of animation within a given crowd pattern, the same luminescent pattern or sequence of patterns may be displayed by differently located groups of wireless mobile clients at differing times (i.e. synchronized by location). Accordingly, it is possible to visually convey a crowd pattern in the form of an animation or a word that is displayed e.g. letter by letter rather than the entire word appearing in its entirety at a single point in time. Synchronization services **307** of communication server

300 facilitate such luminescent pattern synchronization amongst one or more wireless mobile clients.

In one embodiment of the present invention, synchronization services **307** transmit the current time and a start time to each wireless mobile client for each sequence of luminescent patterns to be displayed. Additionally, a delay time may be included that specifies an amount of time that a wireless mobile client is to delay between the display of one luminescent pattern and the next. For example, communication server **300** may transmit a sequence of ten luminescent patterns to each wireless mobile client participating in one or more crowd patterns. Included with the sequence, or subsequent to the sequence, would be a time at which each respective wireless mobile client should begin the display of the sequence of luminescent patterns as well as a duration (e.g. 0.1 sec) for which each respective wireless mobile client is to delay before displaying the next luminescent pattern included within the sequence of patterns. The delay duration may vary by device, and the amount of delay time that elapses between the display of one luminescent pattern and the next need not be constant as each pattern may be associated with its own measure of delay. Furthermore, the delay durations may be determined based upon one or more factors/properties including the distance between a given client device and another (e.g. previous/next) client device. Accordingly, the perceived motion of the overall image may remain constant, or alternatively, the perceived motion may accelerate or decelerate if desired.

In another embodiment, synchronization services **307** periodically broadcast timing signals that are spaced apart over a stipulated interval such as e.g. 0.1 seconds.

The timing signals need not be transmitted using the same transport medium as the luminescent patterns. In one embodiment, the timing signals are transmitted over Radio Frequency (RF) via a low-power radio transmitter located at the venue, whereas the luminescent patterns are distributed via a packet-based transport. In other embodiments, the luminescent patterns and timing signals are transmitted using the same transport medium. When a wireless mobile client having received a sequence of luminescent patterns also receives such a timing signal, the wireless mobile client displays the next luminescent pattern in the sequence. In order to address the issue of wireless mobile clients becoming unsynchronized due to one or more clients missing one or more timing signals (e.g. due to a temporary loss of service), each timing signal may include a sequence number corresponding to one luminescent pattern in the sequence of patterns. Accordingly, if a wireless mobile client misses one or more timing signals, the client can skip the display of the luminescent pattern(s) corresponding to the missed signal(s).

In yet another embodiment, synchronization services **307** of communication server **300** may provide synchronization data including data to indicate delays between luminescent displays as well as a benchmark synchronization signal to indicate where within a display sequence a wireless mobile client should be with respect to its progress. If the wireless mobile client were to fall behind (or to speed up) with respect to the specified delay and/or display times, the wireless mobile client may rely upon the benchmark synchronization signal for timing adjustment purposes.

Figures 4A-4C illustrate various example data organizations suitable for use to store various visualization configuration related information for practicing the present invention, in accordance with one embodiment. More specifically, **Figures 4A-4C** represent data that may be provided to a communication server by a wireless mobile client during a registration process, as well as data representations of one or more luminescent patterns pre-defined within communication server **300**.

Figure 4A illustrates a data organization containing event code field **402**, locator reference field **404**, client identifier field **406** and display pattern field **408**. As described above, event code field **402** identifies a particular event and/or venue to a communication server, whereas client identifier field **406** identifies a particular client to the communication server. In accordance with one embodiment of the invention, the data appearing in the table of **Figure 4A** (with the exception of client identifier **406**) is pre-stored for use in association with an interactive voice response service of the communication server accessible to one or more wireless mobile clients via a generic dial number. In alternate embodiments, the data appearing in the table of **Figure 4A** is accessible to one or more wireless mobile clients via a web interface and e.g. a specified URL, as well as other non-voice related means. By calling the generic number for example, wireless mobile clients are prompted to identify an event code, and optionally a locator reference to the system.

Either one or both of the event and locator reference codes may be provided to users through e.g. an event publication such as a brochure or ticket stub, or through a preprogrammed storage medium integrated with an interchangeable covering of e.g. a wireless mobile phone (also referred as "active" skin for certain embodiments as

described e.g. in U.S. provisional patent application no. 60/306,326), which when used in combination with a given one of wireless mobile clients **108**, facilitates automatic registration. In one embodiment, a user is granted the right to download/access data associated with the display of one or more luminescent patterns by virtue of their paying the admission price to an associated event and/or by purchasing an identified "active" skin.

Upon providing such event and locator data to the communication server for example, the user may be requested for a client identifier, or the identifier may be obtained automatically through e.g. DNIS or via embedded codes within an "active" skin. Once obtained, the client identifier is stored in association with the locator reference code for subsequent transmission of one or more luminescent patterns (i.e. as indicated by display pattern field **408**) to the wireless mobile client. If an event-specific dial number is used to access the voice response system rather than a generic dial number being used, event code field **402** may be omitted. Likewise, if an event-specific web interface is utilized, event code field **402** may similarly be omitted.

Figure 4B illustrates a data organization further containing control vector field **410**. In accordance with one embodiment, data within control vector field **410** is pre-stored as representations of luminescent patterns to be displayed, either independently or in sequence as an animation. For example, if a predefined luminescent pattern identified by the numeral "1" is to be displayed (e.g. as indicated by pattern display field **408**), communication server **300** performs a lookup to determine control codes needed to effectuate the desired luminescent patterns. In **Figure 4B**, the control codes are illustrated as a group of binary "1"s and "0"s with "0" denoting an "off" state and "1"

denoting an "on" state for the light emitting devices (e.g. LEDs) of a wireless mobile client. Depending upon implementation, the control vector may indicate operating states and intensities for single color or multicolor LEDs.

Lastly, **Figure 4C** illustrates another data organization showing that not only may the luminescent patterns to be displayed vary by event (as shown in **Figure 4B**), but the luminescent patterns to be displayed may also vary by location of the wireless mobile device. The luminescent patterns may also vary according to other criteria, such as the capabilities of the device (e.g. as discovered during a previous negotiation period with a server or in real-time by transmitting several instruction sets and having the device choose the correct one) or what services/features the owner of the device has purchased, asked for, enabled, or otherwise passively or actively selected.

Figure 5 illustrates an exemplary operational flow of one embodiment of the present invention. As illustrated in **Figure 5**, a wireless mobile client device establishes a communication session with a communication server, **block 502**. Once the wireless mobile client is in communication with the communication server, the wireless mobile client registers itself with the communication server, **block 504**. As described above, wireless mobile clients may each register with the communication server through entry of a client-specific identifier such as a dial number associated with a particular wireless mobile client. Alternatively, the communication server may automatically determine client-specific identifiers.

Once a wireless mobile client has registered with the communication server, the communication server determines a crowd image or animation to be displayed, **block**

505. Next, the communication server identifies one or more of the luminescent patterns that comprise the crowd image for transmission to the particular wireless mobile client, **block 506**. Such a determination may be based upon one or more criteria such as the location of wireless mobile client including venue and seating location, the overall crowd pattern to be conveyed, as well as the capabilities of the particular wireless mobile client. More specifically, the communication server may store data representing a hardware configuration (e.g. amount of memory, number of LEDs, single or multicolor LEDs, etc) for each wireless mobile client, and may determine which luminescent patterns are to be transmitted and subsequently displayed by the wireless mobile client based at least in part upon the stored hardware configuration. For example, if the communication server identifies a particular wireless mobile client as having a certain memory capacity that is greater than an established threshold, the communication server may opt to transmit a sequence of luminescent patterns to the wireless mobile client rather than transmitting one luminescent pattern at a time. Such configuration information may be provided to the communication server in a number of ways including by way of voice or DTMF input from a user.

Once the appropriate luminescent patterns have been identified, the communication server then transmits the luminescent patterns to the wireless mobile client, **block 508**. In the illustrated embodiment, the communication server further includes synchronization information with the luminescent patterns, **block 510**. The synchronization information serves to synchronize the cooperative display of one or more luminescent patterns amongst multiple wireless mobile clients. Once a wireless mobile client receives the one or more luminescent patterns, the client displays the

luminescent pattern(s) to visually convey the larger crowd pattern based upon any synchronization constraints that may have been imposed by the communication server, **block 512**. In accordance with the illustrated embodiment, if there are additional patterns to be transmitted to the wireless mobile client (**block 514**), the wireless mobile client continues to receive one or more additional luminescent patterns (**block 506**) while the wireless mobile client displays the one or more original luminescent patterns (**block 512**) (described further with respect to **Figure 6** below). If there are not any additional patterns to be transmitted to the wireless mobile client, the next crowd image to be displayed is then determined, (**block 505**).

Variations to the above-described operational flow are also contemplated. For example, if at **block 506**, the communication server identifies e.g. 100 patterns to be transmitted to a wireless mobile client, at **block 508** the communication server may transmit all 100 patterns. Accordingly, at **block 510**, the communication server may then identify (and transmit) synchronization information that instructs the client to display each of the patterns at a given interval such as e.g. 0.1 sec. Finally at **block 514**, the communication server would determine the next crowd image to be displayed.

Additionally, in the event that the crowd image approximates a live video feed, or is representative of a tape delayed video stream for example, the various luminescent patterns are determined at **block 506** such that each luminescent pattern represents one still-image frame of the source video. At **block 508**, the communication server transmits all patterns to the client where they are then displayed (**block 512**) in accordance with any synchronization information that may also be stipulated by the communication server. In one embodiment of the invention, the processes associated

with blocks **506-514** are repeated in parallel for multiple sets of clients, where those clients receiving the same patterns and synchronization data represent a set of clients.

Figure 6 illustrates an exemplary operational flow performed by visualization controller **212** and visualization agent **204** of wireless mobile phone **200** to display one or more luminescent patterns, in accordance with one embodiment. As illustrated, upon receipt of a request to selectively activate or deactivate selected ones of LEDs **214** in selected manners, block **602**, visualization controller **212** determines if the request is of the first type (i.e. a single round request type), or of the second type (i.e. the multiple rounds/cycles request type), block **604**. The distinction of the two types may be explicitly specified or implicitly inferred based at least in part on the format and/or substance of the calling parameters included with the function call. If the request is determined to be of the first type (i.e. a single round request type), visualization controller **212** activates and/or deactivates selected ones of LEDs **214** as requested, block **605**. If the request is determined to be of the second type (i.e. a multiple round/cycle request type), after retrieving the "specification" for the activations/deactivations to be performed, block **606,** visualization controller **212** activates and/or deactivates selected ones of LEDs **214** as requested, block **608**. For a multiple round request, the activation/deactivation operation of LEDs **214** of block **608** is iteratively performed for a sufficient number of times to achieve the selective activation/deactivation requested.

Although the present invention has been described herein as utilizing a communication server to transmit representations of the luminescent data to the

wireless mobile clients, such luminescent pattern representations may also be pre-provided with the wireless mobile clients, or retrieved from a storage medium attached to or integrated with a wireless mobile client. In one embodiment, an interchangeable covering of e.g. a wireless mobile phone ("active skin") may be used to provide such luminescent pattern representations. In other embodiments, other devices that the wireless mobile clients are capable of communicating with may provide the luminescent representations, or the representations may be entirely generated within the wireless mobile clients.

Having now described the present invention from a function view, in particular, the various relevant operational flows, we turn now to describe various exemplary embodiments for disposing and configuring the various elements for practicing the luminescent visualizations of the present invention. **Figures 7A-7B** illustrate an external view of a wireless mobile phone **200a**, incorporated with the visualization teachings of the present invention, in accordance with one embodiment. More specifically, **Figure 7A** illustrates a side view of wireless mobile phone **200a**, whereas **Figure 7B** illustrates a front view of wireless mobile phone **200a**.

For the illustrated embodiment, as alluded to earlier, wireless mobile phone **200a** includes antenna **720**, speaker **722**, visual display **724**, input key pad **726** having input keys **728**, microphone **730**, and so forth. More importantly, wireless mobile phone **200a** includes LEDs **714a** disposed on a side exterior surface of the body of wireless mobile phone **200a**. In alternate embodiments, LEDs **714a** may be disposed on or in other exterior surfaces of the body of the wireless mobile phone **200a** instead. These other

exterior surfaces may include the top or bottom exterior surface, and the front or back exterior surface. Note that by virtue of the manner content is displayed in visual display **724**, the exterior surfaces corresponding to the top, bottom, side, front and bottom surface are definitively defined.

For the illustrated embodiment, LEDs **714a** are disposed on the side exterior surface in a substantially columnar manner, along imaginary longitudinal axis **711**. In alternate embodiments, LEDs **714a** may be arranged in other configurations, e.g. in multiples of even or uneven rows and/or columns. In one embodiment, LEDs **714a** are single colored LEDs of the same color. In alternate embodiments, they are single colored LEDs of different colors. In various embodiments, every three single colored LEDs of different colors (e.g. one Red, one Green, and one Blue) are grouped, functionally forming multiple 3-LED groups to facilitate manifestation of other non-basic colors, such as orange, yellow and so forth. In yet other embodiments, at least some of LEDs **714a** are multi-colored LEDs. A multi-colored LED is a LED that is capable of emitting light in a selected subset of one or more of a plurality of colors.

Figures 8A-8B illustrate an exposed view of wireless mobile phone **200b**, in accordance with an alternate embodiment. More specifically, **Figure 8A** illustrates an exposed front view of wireless mobile phone **200b** with its front cover **821** removed, whereas **Figure 8B** illustrates an exposed interior (or backside) view of front cover **821**. Front cover **821** is also referred to as an interchangeable face plate.

Similar to the embodiments of **Figures 7A-7B**, wireless mobile phone **200b** includes speaker **822**, visual display **824**, input keys **828**, microphone **830**, and so forth. In one implementation, wireless mobile phone **200b** further includes a radio (not

shown). Correspondingly, front cover (face plate) **821** has "opening" **823** for speaker **822**, "opening" **825** for visual display **824**, "opening" **827** for input keys **828**, "opening" **829** for microphone **830**, and so forth.

More importantly, wireless mobile phone **200b** includes LEDs **714b** disposed on the interior front surface of wireless mobile phone **200b**, near or around input keys **828**. With front cover (face plate) **821** in place, LEDs **714b** appear to be integrally disposed with input keys **828**. In other words, for the illustrated embodiment, LEDs **714b** are disposed and configured as an array of light sources. Similar to the embodiment of **Figures 7A-7B**, LEDs **714b** may be single colored LEDs of the same or different color. Every three different color single colored LED, such as one Red, one Green and one Blue, may be grouped to form groups of LEDs as earlier described. In alternate embodiments, at least some of LEDs **714b** may be multi-colored LEDs.

As will be described in more detail below, front cover (face plate) **821** may be an "active" front cover/face plate having an electronic component wherein all or portions of the visualization teachings of the present invention are implemented. In particular, in various embodiments, "active" front cover (face plate) **821** is an "active" covering "skin" covering all or a portion of the body of wireless mobile phone **200b**. For these embodiments, instead of being disposed and configured on the interior front surface of wireless mobile phone **200b**, LEDs **714b** may be disposed on the exterior surface of the "active" interchangeable front cover (face plate) or covering "skin" instead as described e.g. in U.S. provisional patent application no. 60/306,326.

Figure 9 illustrates an internal component view of wireless mobile phone **200**, in accordance with one embodiment. As illustrated, wireless mobile phone **200** includes the earlier mentioned microprocessor **903**, transmitter/receiver (TX/RX) **913** (also known as transceiver), and so forth, coupled to each other as shown. Additionally, for the illustrated embodiment, wireless mobile phone **200** further includes digital signal processor (DSP) **902**, communication interface **911**, and general-purpose input/output (GPIO) **915**, coupled to each other and to the earlier described elements as shown. Most importantly, wireless mobile phone **200** includes LEDs **214** and non-volatile memory **910** having visualizer **202a** stored therein.

In addition to the conventional functions performed by these elements, the elements are employed to practice the visualization teachings of the present invention earlier described. In particular, among the conventional functions, it is expected that TX/RX **913** may support one or more signaling protocols, including, but not limited to, code division multiple access (CDMA), time division multiple access (TDMA), global system for mobile communications (GSM), cellular digital packet data (CDPD), and so forth. Similarly, communication interface **911** may support one or more serial, parallel and/or wireless communication protocols.

In alternate embodiments, other elements may be added or one or more of the illustrated elements omitted, without departing from the spirit and scope of the present invention. Also, some or all of these elements may be present in a separate detachable device that communicates with the wireless mobile clients via an electrical or optical signaling protocol.

Figure 10 illustrates an internal component view of an "active" version of interchangeable "cover" **821**, in accordance with one embodiment. As illustrated, "active" interchangeable "cover" **821** includes in particular, electronic component **1020**. For the illustrated embodiment, interchangeable "cover" **821** also includes LEDs **214** (disposed and configured on an exterior surface).

In one embodiment, electronic component **1020** is a memory device, e.g. a subscriber identity module (SIM). In alternate embodiments, it may be a microprocessor having embedded memory. For these embodiments, at least visualization agent **204** is stored in the embedded memory. In various embodiments, the entire visualizer **1102**, including visualization controller **212**, as well as agent **204** is stored in the embedded memory. In other words, for these embodiments, the visualization ability is additionally provided or partially provided to wireless mobile phone **200** through the employment of an "active" interchangeable "cover" **821** (i.e. face plate or covering skin), having embedded electronic component **1020** including all or a portion of visualizer **202b**.

Thus, it can be seen from the above description, methods and apparatuses for supplementing wireless mobile communications with visualization of various luminescent patterns to improve communication and entertainment value have been described. As mentioned earlier, while the present invention has been described in terms of the above-illustrated embodiments, the present invention is not limited to the embodiments described. The present invention can be practiced with modification and alternation within the spirit and scope of the appended claims. For example,

predetermined luminescent patterns may be pre-provided, downloaded or retrieved from the integrated electronic component of an interchangeable cover plate ("active" skin). Further, the predetermined patterns may correspond to a theme, such as a sports theme, holiday theme, cultural theme, and the like. Thus, the description is to be regarded as illustrative instead of restrictive with respect to the present invention.